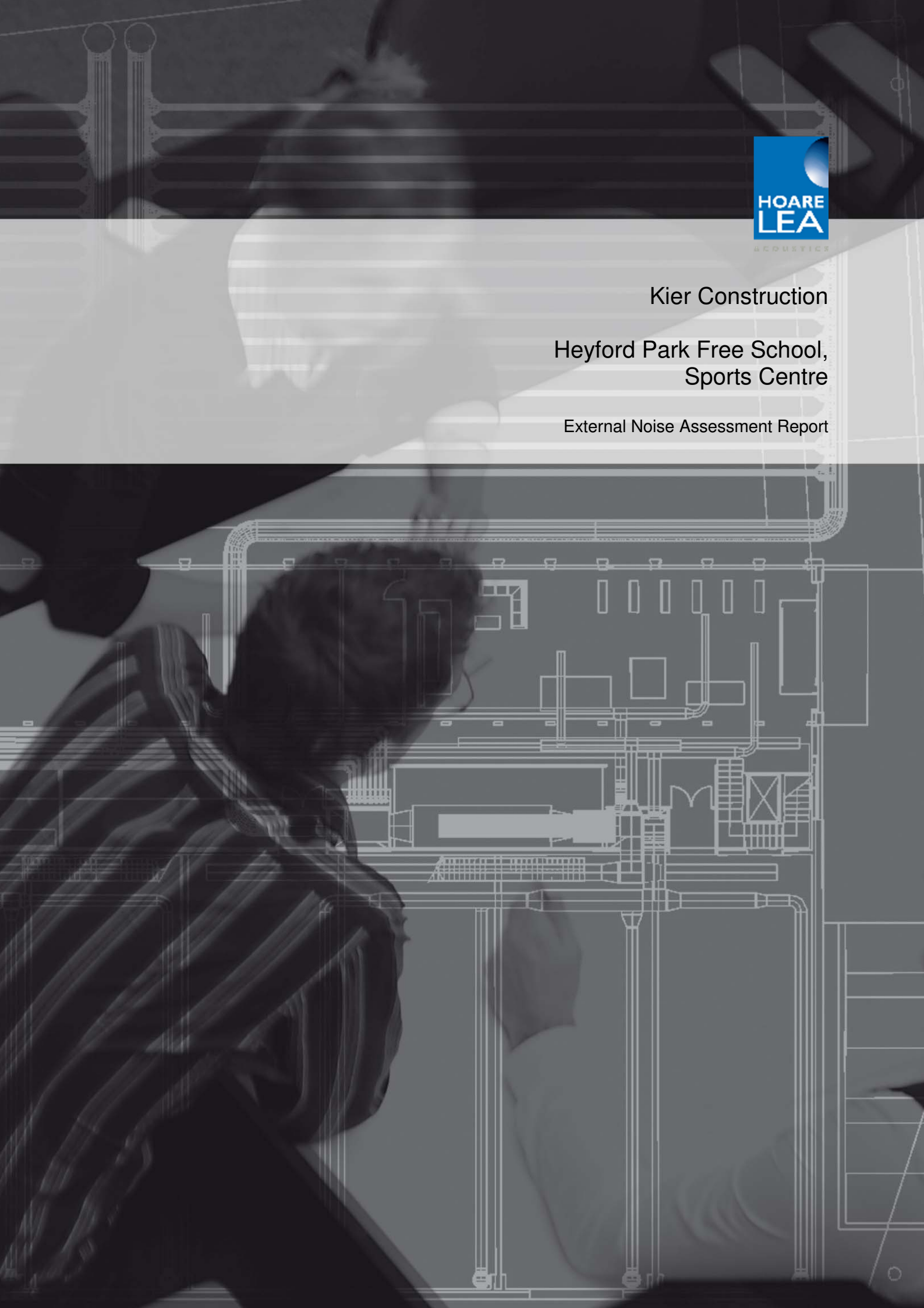

Kier Construction

Heyford Park Free School, Sports Centre

External Noise Assessment Report

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Audit Sheet

Revision	Description	Date	Issued by	Reviewed by
Draft	For Review	11/02/2013	RH	KS
1	For Issue	14/02/2013	RH	KS

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1.0 Introduction

Hoare Lea Acoustics has been appointed by Kier Construction to act as acoustic consultant in connection with the proposed new Sports Hall refurbishment at Heyford Free School, Upper Heyford.

This report presents the details of the noise survey conducted at site and proposes appropriate limits for fixed plant noise emissions.

2.0 Site Description

2.1 Proposed Site

The proposed site is located to the South of Camp Road, Upper Heyford, on the former Heyford Air Force Base site. The proposal comprises a refurbishment of the existing Sports Hall building to provide classrooms and various teaching spaces for the new Heyford Park School development. To the East are existing residential properties. Surrounding the site is a sparse mix of disused buildings commercial properties and playing fields.

The proposed new building comprises standard classrooms, changing facilities, Music/Drama areas, the sports hall, staff areas and administration office space. A layout showing the building footprint and measurement positions is shown in Figure 1 attached.

2.2 Local Noise Conditions

The surrounding noise climate is formed predominantly by distant road traffic noise from the surrounding road network. Occasional aircraft flyovers are also noticeable. It should be noted that bird and foliage noise was also audible.

3.0 Applicable Guidance and Standards

3.1 National Planning Policy Framework

The National Planning Policy Framework [(1)] sets out the Government's current planning policies for England and how these are expected to be applied.
With regards to local noise planning policies, Section 11 paragraph 123 of the NPPF states:

'Planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put upon them because of changes in nearby land uses since they were established;
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'

Reference is made to the DEFRA Noise Policy Statement for England 2010 (NPSfE). This latter document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

The NPSfE advises that the impact of noise should be assessed on the basis of adverse and significant effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have 'a single objective noise-based measure…that is applicable to all sources of noise in all situations'. It further advises that the sound level

at which an adverse effect occurs is 'likely to be different for different noise sources, for different receptors and at different times'.

In the absence of specific guidance for assessment of environmental noise within NPPF and NPSfE it is considered appropriate to base assessment on current British Standards and national guidance. Currently, the Government advice for educational facilities is to follow Building Bulletin 93 (BB93).

3.2 Building Bulletin 93 (BB93)

Building Bulleting 93 [(2)] (BB93) is the current Building Control requirements document for the acoustic design of schools. It requires an external ambient noise survey to be undertaken to determine the design requirements for internal noise levels dependent on the different ventilation strategies for the proposed new development. BB93 contains stringent design criteria for internal noise levels to promote a good environment for learning and concentration. It has two base criteria, an ambient internal noise level based on the worst case 30 minutes measured in the daytime and a maximum internal noise level for individual external events.

The document also defines a method for determining the internal sound insulation required between teaching spaces and guidance for ancillary spaces. Control of reverberation time is also covered along with guidance on acoustic performance of doors and internal ventilation transfer paths (if applicable).

3.3 BS 4142

BS 4142 [(3)] provides appropriate guidance for assessing commercial operations and services plant noise. This British Standard provides an objective method for rating the likelihood of complaint from industrial and commercial operations. It also describes means of determining noise levels from fixed plant installations and determining the background noise levels that prevail on a site.

The complaints assessment method is based on the subtraction of the measured background noise level from the rating level determined. The rating level is the source noise level (either measured or predicted) corrected for tone or character (if necessary). The difference is compared to the following criteria to evaluate the likelihood of complaint.

- A difference of around +10 dB or more indicates that complaints are likely.
- A difference of around +5 dB indicates a marginal significance for complaint.
- A difference of -10 dB or less is a positive indication that complaints are unlikely.

The objective complaint rating method is only applicable for external noise levels.

3.4 BS 8233

BS 8233[(4)] provides guidance for control of noise in and around buildings, and suggests appropriate criteria and limits for different situations. The criteria and limits are primarily intended to guide the design of new or refurbished buildings undergoing a change of use.

The British Standard provides criteria for reasonable and good resting/sleeping conditions in bedrooms, and working conditions in offices which can be seen in Table 5 in BS 8233.

4.0 Noise Survey Results

To quantify the noise climate at the proposed development site, a noise survey has been conducted by Hoare Lea Acoustics. The survey comprised 4 days of unattended automatic noise measurements by a single logger at an external position equivalent to ground floor level. During the measurement period, temperatures remained cool and dry with light winds varying in both direction and strength. There were some periods of heavy snowfall, which will be discounted in the assessment.

Measurements recorded consisted of five minute samples of ambient noise levels ($L_{eq,5min}$ in dB(A)), event noise levels ($L01_{,5min}$ in dB(A)) and background noise levels ($L_{90,5min}$ in dB(A)). A Time-History graph of these measured results can be seen in Figure 2, attached.

Octave band measurements have been conducted at a ground level position simultaneous with the unattended measurements. The results of the attended noise measurements can be seen in Figure 3, attached. A summary of the external noise levels is presented in Table 1, below.

Assessment Period	**Measured Noise Levels**		
	$L_{A90,5min}$ dB	$L_{Aeq,30min}$ dB	$L_{01,30min}$ dB
School Day (0800 to 1530)	43	51	43-78

Table 1 – External Noise Level Summary

A site plan with the building footprint and locations for both attended and unattended measurements has been included with this report and can be seen as Figure 1, attached.

A list of measurement equipment used is contained in Appendix A.

5.0 Plant Noise Emissions Limits

Noise levels due to plant serving the proposed development are proposed to comply with the noise criteria defined from guidance given in BS 4142 at the nearest noise sensitive premises. These noise emission limits can be seen below.

Assessment Period	**Noise Sensitive Location**	**Lowest Measured Background Noise Level** $L_{A90,5min}$ dB	**Noise Sensitive Premises Noise Emission Limit** $L_{Ar,Tr}$ dB(A)
School Day (0800 to 1530)	Nearest Offices	43	38

Table 2 - Building Services Noise Emission Limits

It should be noted that these are the combined operational noise levels of proposed fixed plant at the nearest noise sensitive façade. For plant noise that is tonal, contains a specific character or is intermittent, a 5 dB(A) 'acoustic feature' penalty must be added in reference to BS 4142. Therefore, in order to provide a worst case design basis, this penalty has been included in the above limits. More stringent criteria may transpire through the planning process and the Planning Consent will take precedence.

6.0 Building Ventilation Strategy

The Northern façade of the Sports Hall abuts Reception, Office, Fitness Suite and the Sports hall itself. The Office space is proposed to utilise an 'open-window' ventilation strategy, which will typically provide 10-15dB reduction from outside to inside. The external noise levels are 11dB above the internal noise limit proposed for Offices by BB93. As the external noise levels are based on a worst-case situation, this should provide acceptable internal noise conditions. It should also be noted that the criteria in BB93 for Office space is for guidance only, as it is considered an ancillary space, not a teaching space.

BS 8233 provides guidance internal noise levels for offices of 40 dB(A) to 50 dB(A). The natural ventilation strategy will also be satisfactory compared to the criteria of BS 8233.

7.0 Summary

Hoare Lea Acoustics has carried out a noise survey at the proposed site and provided advice for the limiting of noise from fixed plant and noise break-in.

Outline guidance for ventilation strategies on the external façades has been included.

8.0 References

1. *National Planning Policy Framework, Department for Communities and Local Government, March 2012.*
2. *Skills, Department for Education and. Building Bulleting 93, Acoustic Design of Schools.*
3. *BS 4142: 1997: 'Method for rating industrial noise affecting mixed residential and industrial areas'.*
4. *BS 8233: 1999: 'Sound Insulation and Noise Reduction for Buildings'*

Figures

Figure 1: Proposed Site Plan and Measurement Locations

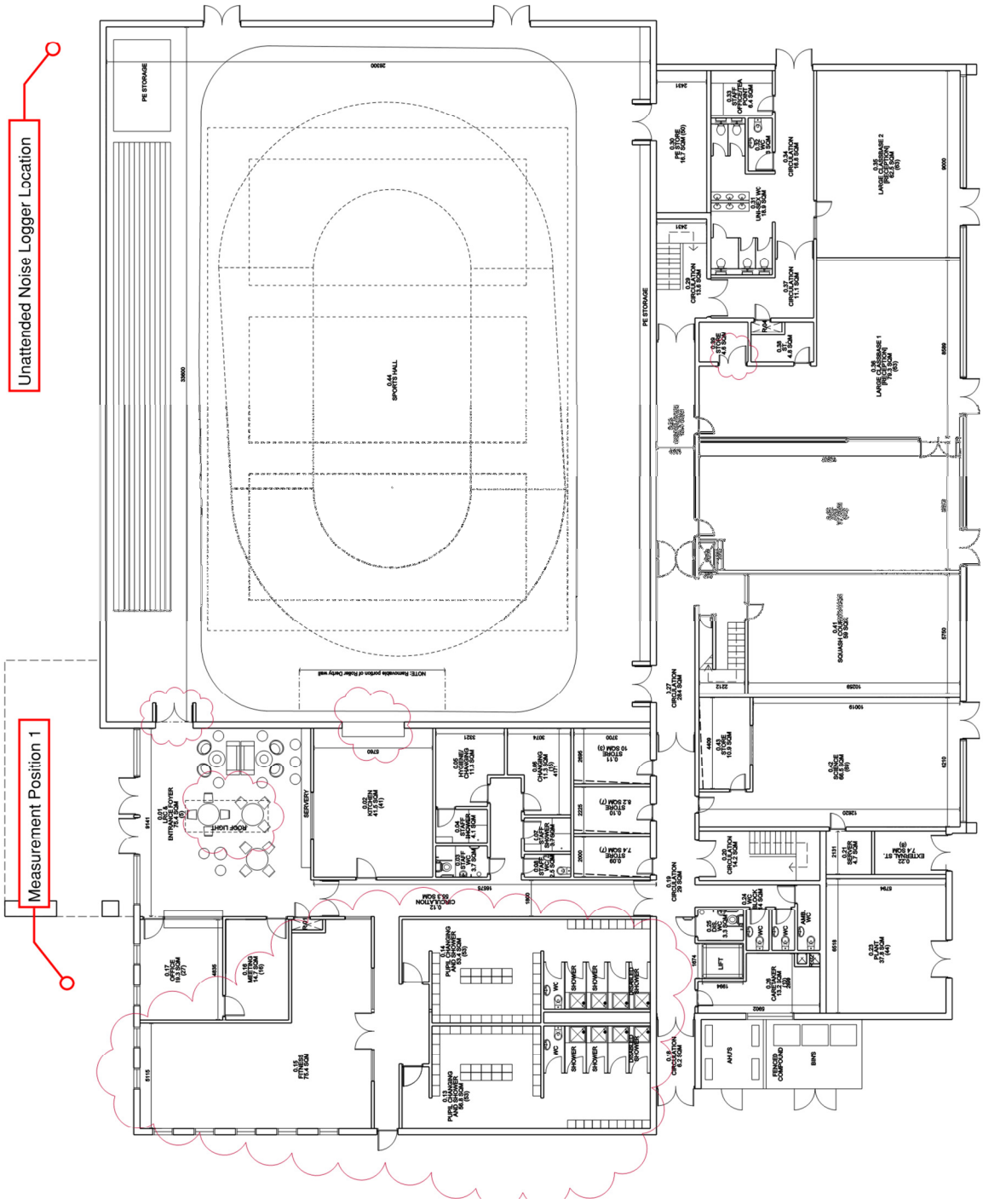

Figure 2: Unattended Measured Noise Levels

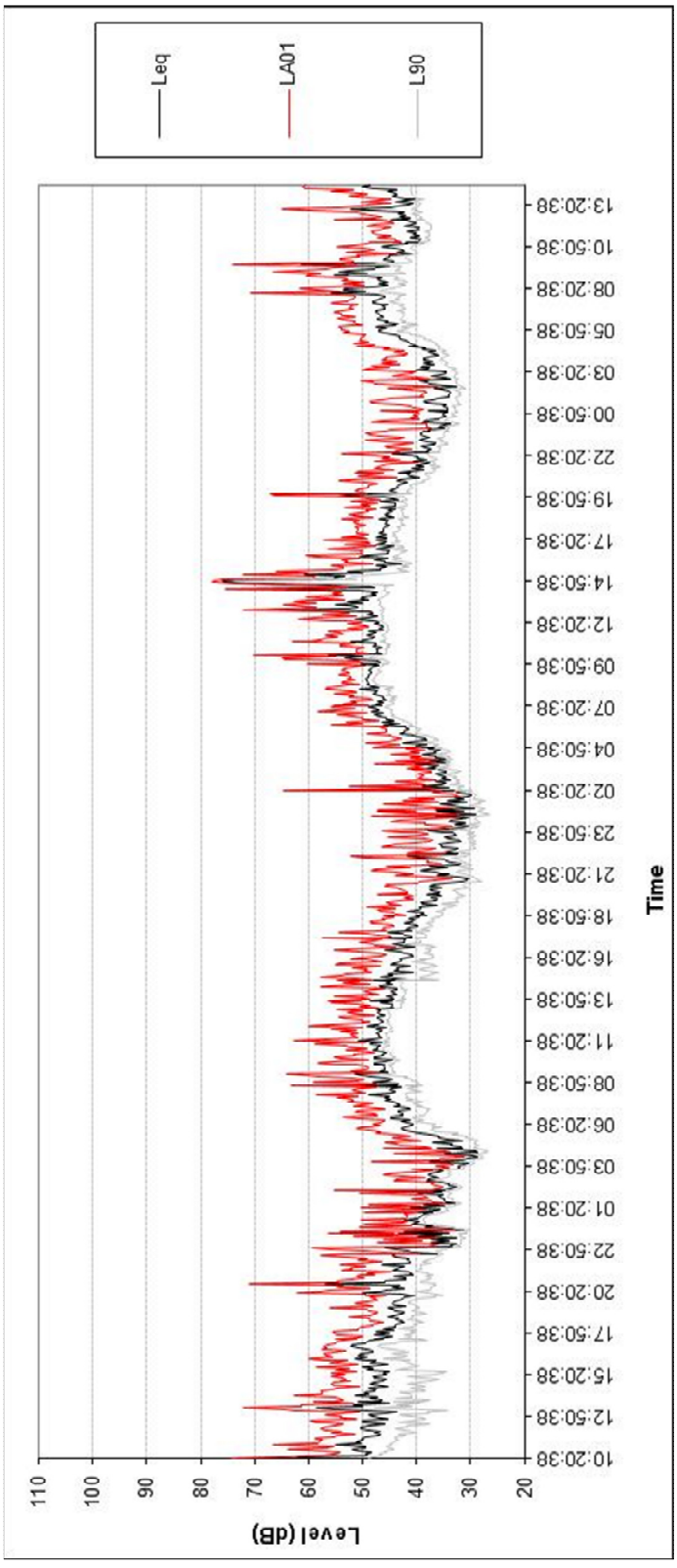

Figure 3: Summary of Attended Noise Measurement Results

Position	Start Time	dB(A) L_{eq}								L_{Aeq} dB	L_{A01} dB	L_{A90} dB
		63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz			
1	14:45:00	56	50	44	40	39	37	31	23	45	48	41

Appendices

A. List of Measurement Equipment

Sound Level Meters (Unattended Measurement Location)

- Rion NL-31 Sound Level Meter (Serial Number 00431026)
- Rion NH-21 Pre-Amplifier (Serial Number 21976)
- Rion NC-74 Sound Calibrator (Serial Number 34851845)
- Rion UC-53A Microphone (Serial Number 311043)

Noise Spectral Analyser (Octave Band Attended Measurement Location)

- Brüel & Kjær 2260 Sound Level Meter (Serial Number 2576726)
- Brüel & Kjær ZC 0026 Pre-Amplifier (Serial Number 3901)
- Brüel & Kjær 4231 Sound Calibrator (Serial Number 2583630)
- Brüel & Kjær 4189 Microphone (Serial Number 2703209)

Sound level meters were field calibrated before and after noise survey and no discernible variations occurred.

B. Acoustic Terminology

Decibel (dB)

The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

The Sound Pressure

The Sound Pressure is the force (N) of sound on a surface area (m^2) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are Nm^{-2} or Pa (Pascal).

Sound is measured with microphones responding proportionally to the sound pressure - *p*. The power is proportional to the square of the sound pressure.

The Sound Pressure Level

The lowest sound pressure possible to hear is approximately $2\ 10^{-5}$ Pa (2 ten billionths of an atmosphere)
.
It therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound

$L_p = 10 \log(p^2 / p_{ref}^2) = 10 \log(p / p_{ref})^2 = 20 \log (p / p_{ref})$ (1)
Where;
L_p = *sound pressure level (dB)*
p = *sound pressure (Pa)*
$p_{ref} = 2\ 10^{-5}$ *- reference sound pressure (Pa)*

Doubling the sound pressure level is an increase of 6 dB.

Sound Pressure Level of some Common Sources

Source	Sound Pressure Level *dB*
Threshold of hearing	0
Rustling leaves	20
Quiet whisper	30
Home	40
Quiet street	50
Conversation	60
Inside a car	70
Loud singing	80
Motorcycle (10 m)	90
Lawn mower (1m)	100
Diesel truck (1m)	110
Amplified music (1m)	120
Jet plane (1m)	130

Frequency

The frequency - cycles per second - of a sound is expressed in hertz - Hz.

Wavelength

The wavelength of sound is the distance between analogous points of two successive waves.

Octave and Third Octave Bands

An octave is the interval between two points where the frequency at the second point is twice the frequency of the first.

The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

A musical octave is eight full tones, and 12 semi tones above or below another tone, with twice or half as many vibrations per second as the other tone. Where a semi tone is $2^{\wedge(1/12)}$ times the frequency of the semi tone below.

A-Weighting

The 'A' weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies. An 'A' weighted value would be written as dB(A), or including A in the parameter term.

$L_{eq,T}$

The $L_{eq,T}$ is a parameter defined as the equivalent continuous sound pressure level. Over a defined time period 'T', it is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal. The $L_{eq,T}$ can be seen to be an "average" sound pressure level over a given time period (although it is not an arithmetic average). Typically the $L_{eq,T}$ will be an 'A' weighted noise level in dB(A). It is commonly used to describe all types of environmental noise sources.

$L_{10,T}$

The $L_{10,T}$ is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe road traffic noise.

$L_{90,T}$

The $L_{90,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'. It is a statistical parameter and cannot be directly combined to other acoustic parameters. It is generally used to describe the prevailing background noise level or underlying noise level.

$L_{max,\ T}$

The $L_{max,\ T}$ is maximum noise level measured during the specified period 'T'.

Free Field

A measurement taken in the free field is at least 3.5m from reflecting vertical surfaces and 1.2m from the ground.

Façade

A measurement is influenced by the reflection of sound from the façade of a building within 3.5m. A façade measurement is made 1m in front of the vertical building surface.

Fast /Slow Time Weighting

Sound level meters can take averages using fast or slow response times.

D_{nT}

The difference in sound level between a pair of rooms, in a stated frequency band, corrected for the reverberation time. See BS EN ISO 140-4:1998.

$D_{nT,w}$

A single-number quantity which characterizes the airborne sound insulation between rooms. See BS EN ISO 717-1:1997

$D_{nT,w} + C_{tr}$

A single-number quantity which characterizes the airborne sound insulation between rooms using noise spectrum no. 2 as defined in BS EN ISO 717-1:1997. See BS EN ISO 717-1:199

C_{tr}

The correction to a sound insulation quantity (such as $D_{nT,w}$) to take account of a specific sound spectra

R_w

A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1:1997.

Sound reduction index (R_i)

A quantity, measured in a laboratory, which characterizes the sound insulating properties of a material or building element in a stated frequency band. See BS EN ISO 140-3:1995.

Specific Noise Level, $L_{Aeq,Tr}$

This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval.

Rating Level, $L_{Ar,Tr}$

This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval that includes adjustments to account for characteristic features of the noise source.